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The fluorite has possibly also some connection with the presence of the telluride, as fluorite is common elsewhere where telluride ores occur.

The ore constituents were probably introduced in a liquid form, probably hot and probably hastened by steam and other vapors. The process of deposition was largely one of replacement; this may have been by chemical action or by deposition in minute cavities after the removal of constituents of the country rock. The latter Dr. Penrose thinks more probable. The deposition was caused principally by chemical reaction with other solutions rather than by reaction with the country rock.

It is to be regretted that a direct investigation of the problems of the source of the ores and their mode of deposition could not have been made. The study given to the subject is confessed to have been inadequate for final results. Though the conclusions reached by the author seem quite probable, they can be classed only as probabilities pending complete inquiry.

As a final criticism of this in so many respects valuable and excellent report, the cuts or the figures illustrating it might have been improved upon. They are somewhat too diagrammatic and most of them seem to be more of illustrations of the writer's ideas than actual sketches "from life" in the mine. This does not apply to all of the figures, nor to the small mine maps or plates which are inserted. These are excellent and appear to have been carefully compiled from the mine surveys.

ARTHUR WINSLOW.

TELLURIDE, COL.,
January 5, 1897.

Glacier Bay and its Glaciers. By HARRY FIELDING REID. United States Geological Survey, 16th Annual Report, 1894–5, pp. 415–461. Plates LXXXVI–XCVI.

The studies of Muir glacier conducted by Professor Reid in the summer of 1890, and the results published in the *National Geographic Magazine*, Vol. IV, were continued and extended in the summer of 1892 and the results recorded in the report named above. During the earlier expedition, attention was restricted to Muir glacier and its tributaries, of which an excellent map was published; the later expedition had for its main object the exploration of the western extension of Glacier Bay with its numerous inlets and many glaciers.

The topographic work of the two expeditions referred to is combined on the map accompanying the report under review. This map showing ice, land, water, and moraines, is published on a scale of six miles to one inch, and embraces the entire extent of Glacier Bay, and its inlets. The extremities of all of the tidewater glaciers which discharge into the waters of the bay and the greater portion of Muir glacier with its many feeding ice streams, are also included. The numerous fine illustrations, reproductions of photographs, give a more graphic idea, especially of the characteristic features of the ends of the tide-water glaciers, than can be conveyed by written descriptions.

The general features of the shores and islands of Glacier Bay are described, special attention being given to the glaciers and inlets. Glacier Bay to the west of Muir glacier, has seldom been visited and was never surveyed previous to Professor Reid's careful examination. In this new field many important discoveries were made, and a number of geographical features named. Several glaciers were appropriately named in honor of distinguished European geologists.

There are eight glaciers to the westward of Muir glacier which discharge bergs into the waters of Glacier Bay. The extremity of each of these was examined and carfully mapped. The most extensive ice front of any of the nine tide-water glaciers, is that of the Grand Pacific at the extreme western extension of the bay. This glacier at present is divided by a high rockmass, in part island and in part nunatak, but presents an actual ice front 12,500 feet in length. A small recession will separate the ice from the land that divides it and increase the length of its magnificent ice cliffs to fully three miles. The combined extent of the ice frontage of the several tide-water glaciers of Glacier Bay, is between twelve and thirteen miles.

The hard geology about the shores of Glacier Bay and to a limited extent, of the mountains from which Muir glacier receives tributary glaciers, receives attention. Large areas of diorite, quartz-diorite, argillite, limestone, sand and gravel, are shown on a sketch map. A few fossils obtained from loose débris indicate that the limestones are of Carboniferous age.

The stratified gravel and sand containing stumps and trees, beneath the extremity of Muir glacier, and on the adjacent shores, to which considerable attention had previously been given by Professor Reid and others, were again studied and fresh observations made which sustain the conclusion that gravels, etc., were laid down by streams from the glaciers during a period of recession and overridden when the ice readvanced. Some important modifications of this general history are suggested.

Among the many interesting results reported, are observations on variations in the extension of Muir glacier between 1880 and 1892. Records of the position of the extremity of the glacier in 1880, 1886, and 1890, showed an apparently continuous recession of about 250 yards a year, but in 1892 the ice front had advanced on an average of approximately 300 yards beyond its position in 1890. The most marked advance was in the central portion where the ice current is known to be most rapid. In a footnote it is stated that photographs taken in 1894, show a recession to the position occupied in 1890.

The rate of flow of the ice near the end of Muir glacier, as measured by G. Frederick Wright in 1886, and by Reid in 1890, showed great discrepancies which could not be reconciled. This question which has led to some discussion during the past five years, is briefly considered and the accuracy of the measurements made in 1890 maintained. It will be remembered that the maximum rate of flow in the central portion of the glacier near its terminus, was stated in the report of the expedition of 1890 to be about seven feet per day.

A map of the end of Girdle glacier on a scale of 500 feet to an inch, shows the manner in which it thrusts its extremity into the side of Muir glacier, to which it is tributary, so as to cause the lateral moraines on the main glacier to curve about it in rude semicircles. Stakes were placed along the margin of the expanded terminus of Girdle glacier and their direction and rate of movement measured twenty-four days later. The rate of motion varied from 1.8 to 2.6 inches per day; the direction of movement revealed a spreading of the ice of Girdle glacier, and a slow movement in common with the general flow of Muir glacier. Other instructive facts concerning the unique phenomena revealed by Girdle glacier are recorded. The stakes placed in the ice melted out, but their positions were preserved by placing three small iron plates about each one. The plates, as is the rule with small dark objects lying on the ice, sank into it as melting progressed, and thus maintained their position.

Peculiar holes in the surface of Muir glacier, from a few inches to six or eight feet deep, with a diameter of six to eighteen inches, were found to be due to the lowering of the surface by melting, so as to expose cavities that previously existed in the ice. The holes within the ice contain water, and are thought to be due to the closing of water-filled crevasses. The presence of water-filled cavities within the ice of glaciers shows that the winter's cold does not penetrate far below the surface.

An ingenious arrangement consisting of two sticks placed in diverging auger holes and inclined toward each other and securely bound together with wire at the surface of the ice, gave accurate measures of the rate of surface melting. In general, the waste on the surface of Muir glacier was two inches per day. Soundings in Muir inlet, which also furnished water samples from various depths, measurements of temperatures for the surface to the bottom, and samples of the bottom, gave a series of instructive records, which are briefly discussed. Tidal observations made in Tidal inlet, a small fiordlike bay, five miles west of the head of Muir inlet, furnished data for establishing a permanent bench mark on the shore by means of which changes of level of the land can be measured. It is hoped that future travelers will repeat these measurements and also profit by the instructions which are given for photographing the extremities of the tide-water glaciers, so that a record of their variations may be obtained.

The report before us contains the records of the only systematic survey that has been made of any of the Alaskan glaciers, and is of special value on account of the painstaking accuracy that characterizes the work. A splendid beginning has been made in the study of the great system of ice drainage that pours into Glacier Bay. It is to be hoped that other students of glacial phenomena, having before them this example of what can be accomplished during a summer vacation, will continue the work and explore the unknown regions surrounding the area represented in Professor Reid's map on every side.

ISRAEL C. RUSSELL.

Water Resources of Illinois. By FRANK LEVERETT; Seventeenth Annual Report U. S. Geological Survey, pp. 695–849, Washington, 1896.

This paper contains much of distinct geological interest, as may well go without saying, both on account of the intimate connection of hydrology with geology, and, in especial, because of the author's thorough study of the Pleistocene formations of the state. The effect of the drift upon topography and drainage is set forth with considerable detail. On the newer drift, within the Shelbyville moraine,